POINT 2 Heat and Specific Heat Capacity

A. Heat

a. Heat is energy that is transferred from an object of high temperature to an object of low temperature because of the difference in temperature. The SI unit for heat is the joule (J).

b. The heat that flows from a hot object to a cold object originates in the thermal energy of the hot object.

c. When heat flows within an isolated system, the thermal energy of the hot object decreases and the thermal energy of the cold object increases.

d. Heat and thermal energy are also specified in calories or kilocalories. One calorie is the amount of heat needed to raise the temperature of 1 g of water by 1°C.

$1\ \text{cal} = 4.186\ \text{J}$ $4.186 \times 10^3\ \text{J} = 1\ \text{kcal} = 1\ \text{Cal}$ (with a capital C)

B. Specific heat capacity

a. Specific heat capacity of an object is the heat required to change the temperature of unit mass of the object by 1 degree. The common unit for specific heat capacity is J/(kg·°C).

$$Q = mc\Delta T$$

Q: heat absorbed or lost
c: specific heat capacity
m: mass of an object
ΔT: temperature difference

b. Specific heat capacities of common substances

Substance	Specific heat capacity	Substance	Specific heat capacity	Substance	Specific heat capacity
Aluminum	900	Alcohol	2400	Water	4186
Copper	390	Mercury	140	Ice	2100
Glass	840	Marble	860	Steam	2010
Iron (Steel)	450	Silver	230	Human body	3470
Lead	130	Wood	1700	Protein	1700

C. Conservation of energy: Calorimetry

a. When objects at different temperatures are placed in contact, energy is exchanged between them, and the transfer of energy continues until a common temperature is reached at thermal equilibrium.

b. When heat flows within an isolated system, the heat gained by one part of the system is equal to the heat lost by the other part of the system by the conservation law of energy.

$$Q_A + Q_B = m_A c_A \Delta T_A + m_B c_B \Delta T_B = 0$$

c. Calorimetry is the quantitative measurement of heat exchange. A calorimeter is used to make such measurements.

Specific Heat Capacity (c)

① $\boxed{\Delta E_h = m \cdot \Delta t \cdot c}$

- ΔE_h: This is the energy (heat) that has transferred from one place to another. (Joules) (J)
- m: mass (kg)
- Δt: change in temperature $T_2 - T_1$ (T_2 Final, T_1 initial)
- c: Specific Heat capacity of material $\left(\frac{J}{kg \cdot °C}\right)$

$$\Delta E_h = m \Delta T \cdot C$$

$$= (0.800)(80°C - 10°C) \cdot 4186$$

$$= 234416$$

↑ look up on Table

$$\boxed{\Delta E_h = 230\,000 \text{ J}}$$

answer questions to 2 significant figures